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Second Note on the number of Faint Stars with large Proper Motions. By H. H. Turner, D.Sc., F.R.S., Savilian Professor.

1. Last November the results of a comparison of ten pairs of plates in zone +28° taken at intervals of 12 to 15 years were communicated to the Society. Out of 2822 stars examined, 16 showed P.Ms. greater than 15″ per century, and 6 greater than 20″ per century. Of the 16 stars, 7 were brighter than 9·5 magnitude; and of the 6 with P.M. >20″, 3 were bright.

2. The comparison and examination of 30 plates in zone +26° has now been carried out, and I am again glad to acknowledge the volunteer assistance of Mr. J. H. Worthington, F.R.A.S., and Mr. G. H. Hamilton, in remeasuring and checking the cases of possible proper motion. Table I., which follows, shows the general nature of the results. As a rule, all cases have been specially examined where the differences between the plates exceeded ± 1″·2 in either coordinate, and the figures in column 4 give the number of cases where these differences were confirmed on remeasurement and thus probably indicate a P.M., although no stress is laid on these records unless the P.M. exceeds 15″ per century.

Table I.

Zone +26°. Stars having probable large P.Ms.

R.A. of Plate Centre. h	m	Total Stars compared.	Interval. y	Total P.Ms.	Centennial P.Ms. 15″–20″.	>20″.
0	8	162	12·1	3	3	0
0	24	199	14·0	0	0	0
1	4	183	10·9	0	0	0
1	12	227	10·1	1	0	1
1	52	132	8·8	1	0	1
5	36	349	13·1	6	0	0
6	48	303	11·0	5	2	1
7	12	191	9·9	2	1	1
7	44	159	13·0	4	2	0
8	0	145	14·8	5	1	1
8	16	127	15·0	8	2	2
9	4	98	14·9	4	1	3
9	28	126	14·9	2	1	0
10	8	84	12·0	1	0	1
10	24	83	12·0	1	1	0
11	12	65	14·9	5	2	0
12	0	72	14·9	4	0	0
13	4	54	14·9	3	1	0
13	12	35	14·9	5	0	1

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TABLE I.—*Zone* +26°. *Stars having probable large P.Ms.*—continued.

R.A. of Plate Centre.		Total Stars compared.	Interval.	Total P.Ms.	Centennial P.Ms.	
					15″–20″.	>20″.
h	m		y			
13	20	41	14·9	2	0	0
13	44	56	14·9	5	1	0
13	52	91	14·9	5	3	1
15	36	109	12·1	0	0	0
18	32	649	13·9	11	5	0
19	12	734	14·2	4	0	2
20	24	438	12·2	4	3	0
20	32	504	12·2	1	0	1
20	40	515	9·9	4	2	2
21	44	332	14·2	4	0	2
23	20	247	10·9	1	1	0
Totals		6510	...	101	32	20
From previous paper		2822	...	50	10	6
Grand Total		9332	...	151	42	26

3. The important point is brought out by these new results, that the crop of large P.Ms. is not much greater for a plate in the Milky Way containing 800 stars than it is for one in a region far removed from the Galaxy, having only 50 stars on it. To show this, the plates are arranged in Table II. according to the number of stars compared, and the results of the previous paper have been included in order to lengthen the series.

TABLE II.

Plates in Order of Number of Stars.

No. Stars.	P.Ms.		No. Stars.	P.Ms.		No. Stars.	P.Ms.		No. Stars.	P.Ms.	
	15″–20″	>20″.		15″–20″	>20″.		15″–20″	>20″.		15″–20″	>20″.
734	0	2	308	0	1	191	1	1	98	1	3
649	5	0	303	2	1	183	0	0	91	3	1
515	2	2	294	0	2	182	0	1	84	0	1
504	0	1	264	3	1	162	3	0	83	1	0
438	3	0	253	1	0	159	2	0	72	0	0
431	1	0	247	1	0	145	1	1	65	2	0
359	1	0	230	1	1	132	0	1	56	1	0
349	0	0	227	0	1	127	2	2	54	1	0
332	0	2	199	0	0	126	1	0	41	0	0
310	2	0	191	1	0	109	0	0	35	0	1
4621	14	7	2516	9	7	1516	10	6	679	9	6

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There are 10 plates in each group, and the average number of stars compared falls from 475 to 68; but the number of P.Ms. >20″ per century is sensibly steady; and though there is a slight drop for those between 15″–20″, it is nothing like the drop in the number of stars per plate.

4. Hence we may apparently expect to find these stars of large P.M. uniformly scattered over the sky, and not becoming more numerous near and in the Milky Way. Do they belong to our "Solar Cluster"?

5. Incidentally, the small number of large P.Ms. per cent. of the stars examined in the last paper is explained; for the plates were chiefly near the Milky Way, and here the percentage of large P.Ms. is least. Taking the average *per plate*, irrespective of the number of stars on it, we get 1·00 per plate for 15″–20″ and 0·60 over 20″ in zone +26°, as against 1·00 and 0·67 in zone +28°.

6. The following is a list of the stars having P.M. greater than 15″ per century on these plates in zone +26°.

Table III.

List of large P.Ms. in Zone +26°.

R.A. of Plate Centre.		Oxford Number.	Cent. P.M. in Arc.	Δ*x*.	Δ*y*.	Interval.	Mag.
h	m	+26°	″			y	
9	4	25798	49·6	−19	−16	14·9	11·2
13	52	34278	47·0	−23	−5	14·9	11·0
19	12	...	44·5	+3	−21	14·2	11·8
7	12	20428*	39·9	−13	−3	9·9	8·6
8	0	23419*	38·0	−1	−19	14·8	6·0
21	44	74272*	37·8	−16	−8	14·2	9·2
9	4	25973*	36·8	−7	−17	14·9	6·0
13	12	33210*	31·4	−14	+7	14·9	8·0
20	40	68464	30·9	−5	−9	9·9	11·0
10	8	28107*	30·5	+7	−10	12·0	7·5
20	40	67823	27·6	−2	−9	9·9	11·6
19	12	55357*	27·3	+5	+12	14·2	8·0
1	12	3131*	27·0	+9	+1	10·1	9·2
20	32	66463*	25·0	−8	−6	12·2	9·5
8	16	23968*	24·0	0	−12	15·0	9·2
9	4	25763*	23·4	−11	−4	14·9	9·0
8	16	24107	22·0	0	−11	15·0	10·0
21	44	74061*	21·6	+9	+5	14·2	8·2
6	48	19211	20·6	−3	−7	11·0	12·0
1	52	4673	20·5	+6	+1	8·8	11·2
11	12	30034	19·6	−4	−9	14·9	10·2
6	48	19480*	19·5	−6	+4	11·0	6·7

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TABLE III.—*List of large P.Ms. in Zone* +26°—continued.

R.A. of Plate centre.		Oxford Number.	Cent. P.M. in Arc.	Δ*x*.	Δ*y*.	Interval.	Mag.
h	m	+26°	″			y	
0	8	355	19·5	+ 5	+ 6	12·1	11·0
6	48	19206	19·2	+ 1	− 7	11·0	12·0
20	24	66226	19·0	− 3	− 7	12·2	11·0
13	52	34208*	19·0	− 9	+ 4	14·9	8·5
18	32	50932	18·7	− 3	− 8	13·9	11·8
7	44	22642	18·6	+ 4	− 7	13·0	10·9
0	8	259*	18·0	+ 7	− 2	12·1	9·2
18	32	50702	18·0	− 2	− 8	13·9	11·5
7	44	22647	17·9	− 5	− 6	13·0	10·8
0	8	272*	17·8	− 5	− 5	12·1	8·8
8	16	24256	17·8	− 8	− 4	15·0	9·0
13	52	34238*	17·8	+ 4	− 8	14·9	9·1
18	32	51050	17·6	− 8	0	13·9	11·8
10	24	28528*	17·5	+ 7	0	12·0	8·9
18	32	50936	17·2	+ 5	+ 6	13·9	10·0
8	0	23412	17·0	− 3	− 8	14·8	10·1
8	16	24255*	16·4	− 2	− 8	15·0	8·9
23	20	78862*	19·2	+ 4	+ 4	10·9	8·7
13	52	34290*	16·2	+ 7	− 4	14·9	9·5
13	44	34103	16·0	− 8	0	14·9	10·4
18	32	51291	15·9	− 7	+ 2	13·9	10·7
13	4	33127	15·8	− 4	− 6	14·9	10·0
11	12	30038	15·8	− 6	+ 4	14·9	11·0
20	24	66211	15·8	− 6	+ 2	12·2	11·8
9	4	25941	15·6	− 6	− 5	14·9	10·0
7	12	20681*	15·3	− 1	− 5	9·9	9·2
20	24	...	15·3	− 6	+ 2	12·2	11·8
20	40	67632	15·3	− 1	− 5	9·9	11·2
20	40	67901*	15·3	− 1	+ 5	9·9	7·5
9	28	26685*	15·2	+ 7	− 3	14·9	9·4

Two stars were not measured on the plates recorded in the Oxford volume, and have therefore no Oxford number. One is a companion to 66211. The stars marked with an asterisk are in the Cambridge Catalogue, and are bright stars; it will be seen that there are 24 out of 50. The magnitudes for these stars are those of the Cambridge Catalogue. For the other stars the magnitudes are inferred from the formulæ in the printed volume, but are to be taken as provisional only.

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7. If we now group these stars according to magnitude, adding those of the previous paper to make the list as long as possible, we get results as follows, N denoting the *total* number as bright as, or brighter than, the reading.

TABLE IV.

Showing large P.Ms. for successive Magnitudes.

Mag.	To 7·9.	8·9.	9·9.	10·9.	12·0.
N over 20″	5	10	15	19	25
N 15″–20″	3	8	15	25	41
N over 15″	8	18	30	41	66
log N over 15″	0·90	1·26	1·48	1·64	1·83
Diff.		0·36	0·22	0·16	0·19

8. As regards the average P.M., the material is scarcely sufficient as yet to warrant careful treatment; but if we take the average Δx and Δy, we get results as in Table V. for the P.Ms. given in this paper.

TABLE V.

Octant.	Average.		No. Stars.
	Δx.	Δy.	
h h			
0– 3	+ 7	+ 1	4
3– 6	0	− 3	5
6– 9	− 1·5	− 6	22
9–12	− 5	− 5	12
12–15	− 2	− 1	19
15–18			
18–21	− 2	− 1	24
21– 0	+ 1	+ 2	5

9. It seems probable that these stars are much nearer to us than others of similar magnitude. Hence, if there is any selective loss of light in space, as suggested in *Mon. Not.*, lxix. p. 61, and as the experiments of M. Tikhoff seem to confirm, these stars should be visually fainter than those which appear photographically of the same magnitude.

10. The comparison of other plates is proceeding.

Summary.

On 40 plates in zones + 26° and + 28°, containing nearly 10,000 stars, there are 68 stars with P.M. exceeding 15″ per century, of which 26 have P.M. exceeding 20″ per century. There are also 151 other stars with P.Ms. which are smaller, but fairly discernible with the rather rough methods here adopted. The large P.Ms. are scattered uniformly in R.A., with no condensation towards the Milky Way, and thus probably indicate stars belonging to our Solar Cluster.

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On the Theory of Aberration. By H. C. Plummer, M.A.

1. The appearance of Professor Turner's paper on Aberration, in which he has placed in a clearer light the geometrical implications of the accepted law of aberration, suggests that it may be not inopportune to examine, even superficially, the physical aspects of the same question. It is well known to astronomers that recent determinations of the constant of aberration, executed with unimpeachable skill and care, have yielded values which are greater than can be reconciled with the known values of the solar parallax and the velocity of light. Of the three related constants it remains the most uncertain, and the discrepancy suggests either that the simple theory of aberration is not entirely correct, or that the direct determinations of the constant are affected by some source of systematic error which has hitherto been overlooked. The problem is clearly one of great importance, and a review of the position may be useful if it only serves to define the obscurity. The discrepancy is of course very small, yet it is scarcely to be dismissed as a mere result of the accidental errors of observation.

The question will be regarded here from the general standpoint of the undulatory theory, and this rather because it provides as simple a view as any other than because it is to be considered essential. Those text-books may well seem open to criticism in which it is sought to *explain* aberration by simple considerations based on the corpuscular theory of light. The proper view, it may be thought, is to regard the law of aberration as an inductive result of observation which must be taken into account by the physicist in formulating a theory of light.

A different view is, however, possible, and further consideration tends to lead us in this direction. According to the alternative view, the physical importance of astronomical aberration is chiefly historical, and its value in the construction of hypotheses is much less than we might at first suppose.

2. Let us begin by considering the simplest case—that of maximum aberration *in vacuo*. At the time t let fc (fig. 1) be the position of the axis of collimation of a telescope, being defined by a fixed wire at the focus f and the principal point c, and let acb be a plane at right angles to fc. The telescope moves in a direction at right angles to itself, and the axis arrives at the position FC at the time T. Suppose that S is a star, the light from which arrives in a plane wave w, and is converted by the lens system into a spherical wave s. If the light of the star reaches c at the time t and w is parallel to acb, the light will travel from c to the focus f in free ether. Let U be the velocity of light, V the velocity of the telescope, and f the focal length. The passage of the light from c to f will occupy a time $f/\mathrm{U} = \mathrm{T} - t$. In this time the telescope will have moved a distance $f\mathrm{F} = f\mathrm{V}/\mathrm{U}$. Hence the angular displacement of the observed image will be $f\mathrm{CF} = \tan^{-1}\mathrm{V}/\mathrm{U}$. It is assumed here that the lens produces a flat field. If now a bright micrometer wire be